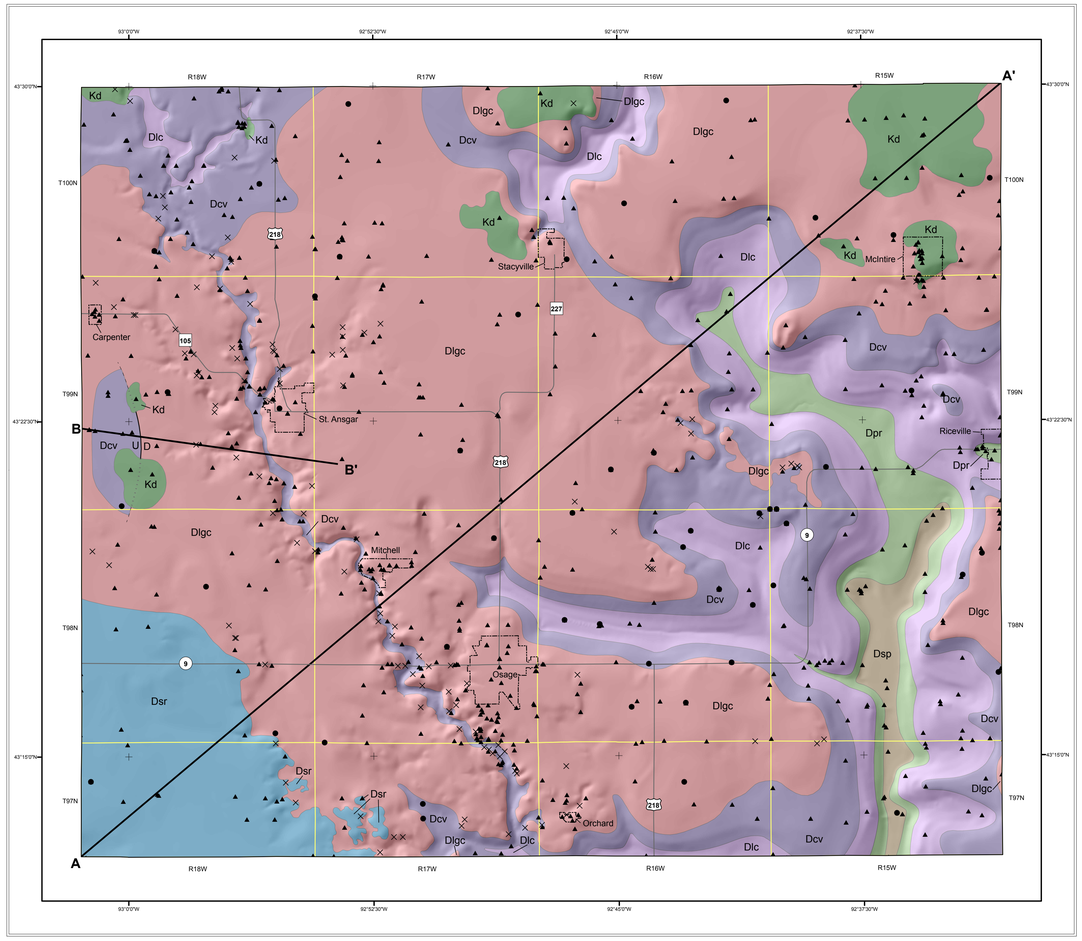
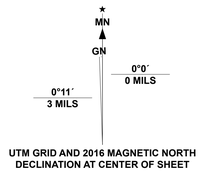
Bedrock Geologic Map of Mitchell County, Iowa



1:100,000

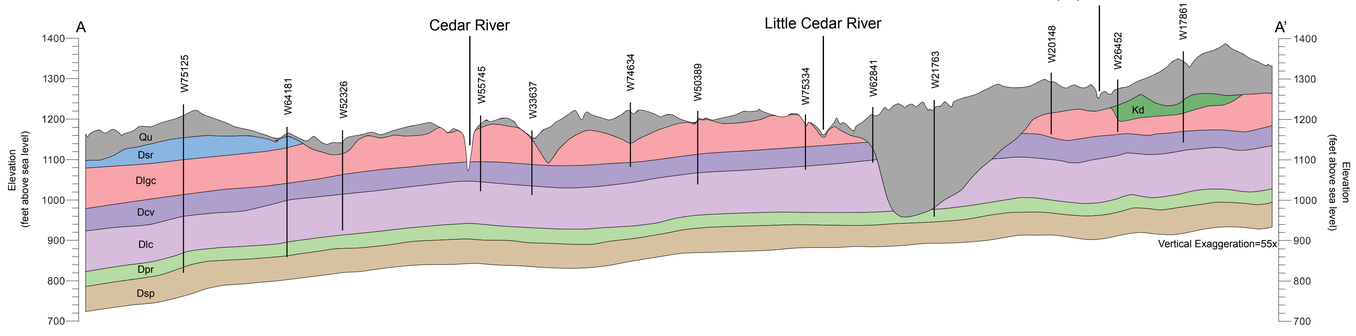
0 1 2 4 6 8 Miles

0 1 2 4 6 8 Kilometers

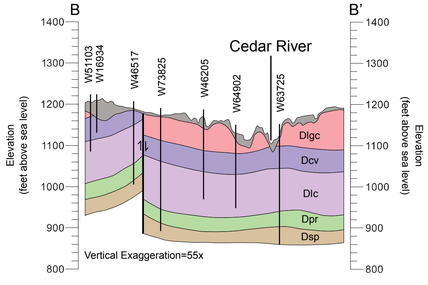


UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

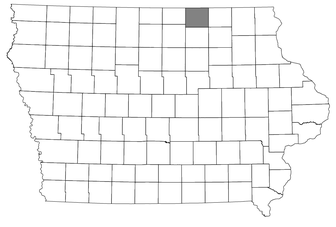
GEOLOGIC CROSS-SECTION A-A'



GEOLOGIC CROSS-SECTION B-B'



Location Map



LEGEND

CENOZOIC

QUATERNARY SYSTEM

Qu - Undifferentiated Unconsolidated Sediment Consists of loamy soils developed in loess, glacial till, and colluvium of variable thickness, and alluvial clay, silt, sand, and gravel. The total thickness of the Quaternary deposits varies between 0 and 14 m (0-45 ft) throughout much of the mapping area, but can be as much as 100 m (330 ft) thick within the prominent bedrock valley in the eastern part of the mapping area. This unit is shown only on the cross-section, not on the map.

MESOZOIC

CRETACEOUS SYSTEM

Kd - Sandstone, Mudstone, and Siderite Pellets (Dakota/Windrow Formation) "Md"-Cretaceous. This map unit occurs as erosional outliers in the northern half of the mapping area. The formation consists of a variety of lithologies including quartz arenite, non-calcareous shale and mudstone, and chert-pebble conglomeratic; with lesser amounts of siderite occurring as granules and pellets. Commonly reddish, although yellow, green, white, gray, and brown are observed both in well cuttings and outcrop. Sandstone and conglomerate lithologies display iron, pyrite, goethite, and chert cementation. Typically identified in well cuttings, although two sand and gravel pits located along the northern boundary of the county provided the only presumed outcrops of this map unit. Possible residuum of this unit was identified in the 'overburden' piles of one limestone quarry located in the northeastern part of the mapping area. The thickness of this unit is variable, usually less than 12 m (40 ft), although observed in one well to be as much as 27 m (90 ft) thick.

PALEOZOIC

DEVONIAN SYSTEM

Dsr - Limestone, Dolomite, and Shale (Shell Rock Formation) Upper Devonian. This map unit forms the bedrock surface in the southwestern corner of the mapping area, usually with a thickness between 2 and 20 m (6-65 ft). The unit is characterized by fossiliferous limestone, dolomitic limestone and dolomite, with some gray to light green shale and/or argillaceous carbonates. Layers containing abundant sub-spherical and digitate stromatoporoids commonly occur in the lower part of the unit. Brachiopods, bryozoans, corals, and crinoids are abundant in some intervals, especially in the upper part of the unit. Outcrops of this unit within the mapping a rea are only found along portions of Rock Creek and in a few quarries along Rock Creek.

Dlgc - Dolomite, Limestone, and Shale (Lithograph City Formation) Middle to Upper Devonian. This map unit represents the majority of the bedrock surface in the mapping area reaching a maximum thickness of 32 m (105 ft). This unit consists of dolomite and dolomitic limestone, partially characterized by interbeds of laminated, lithographic and sub-lithographic limestone and dolomitic limestone, in part argillaceous with minor shale. "Birdseye" structures, vugs, and calcite vug-fills are common, with some layers heavily bioturbated. Some layers are locally brecciated. Occasional intervals of fossiliferous and stromatoporoid-rich carbonates are present in the limestone facies with the lower dolomitic part exhibiting abundant brachiopod molds. Outcrops of this map unit are primarily found along the major river valleys and tributaries in the western two-thirds of the mapping area. Most of the quarries in the county are mining this unit.

Dcv - Limestone and Dolomite (Coralville Formation) Middle Devonian. This map unit is between 12 and 20 m (40-70 ft) thick in the mapping area, generally thinning to the northwest. This unit is dominated by dolomite and dolomitic limestone; in part, laminated, argillaceous, and bioturbated with occasional sub-lithographic limestone. Prominent breccia zones occur in the upper part of the unit. Brachiopods, echinoderm debris, and corals usually occur in the limestone facies and as fossil molds in the dolomite facies in the lower part of the unit. Sparse outcrops can be found along parts of the Cedar and Little Cedar rivers and their tributary creeks.

Dlc - Dolomite, Limestone, and Shale (Little Cedar Formation) Middle Devonian. This map unit can be up to 37 m (120 ft) thick and is dominated by slightly argillaceous to argillaceous dolomite and dolomitic limestone; usually vuggy and partially laminated and/or cherty. A moderately continuous shale unit, usually 3 to 6 m (10-20 ft) thick, occurs within the upper half of the formation. Brachiopod and crinoid fossil molds are common in the dolomite facies throughout this unit with occasional phosphatic fossiliferous units occurring in the limestone facies in the lower portion. This unit occurs at the bedrock surface within moderate bedrock valleys and along the shoulders of deep bedrock valleys in the mapping area.

Dpr - Dolomite and Limestone (Pinicon Ridge Formation) Middle Devonian. This map unit ranges from 9 to 15 m (30-50 ft) in thickness and consists of unfossiliferous dolomite and limestone with minor shale. This unit is typically unfossiliferous and displays a variety of textures and compositions including laminated, pyritic, sandy, and cherty. This unit is characterized throughout the mapping area by being heavily brecciated, mixing all lithologies. The unit occurs at the bedrock surface within the prominent bedrock valley along the eastern margin of the mapping area.

Dsp - Dolomite (Spillville Formation) Middle Devonian. This map unit reaches a maximum thickness of approximately 24 m (80 ft) and is dominated by medium to thick bedded dolomite, commonly vuggy with calcite vug fills and scattered to abundant fossil molds. Sporadic fossiliferous limestone units have been observed. The basal unit, where present, is variably sandy, shaly, and/or conglomeratic with reworked Ordovician chert clasts. This formation only occurs at the bedrock surface within the core of the prominent bedrock valley along the eastern margin of the mapping area.

OTHER FEATURES

- **Bedrock outcrop**
- **New drill holes for this map project**
- **IGS GEOSAM data points**- records available at www.iowageologicalsurvey.com
- W75125 **Wells used for geologic cross-section**
- **Fault** – U is upthrown side, D is downthrown side
- **Fault** - dotted where concealed, dashed where inferred
- **Roads** – with corresponding highway symbols
- **Incorporated city boundary**

STRATIGRAPHIC COLUMN

Lithology Key

Conglomerate
Dolomitic limestone/ calcitic dolomite
Dolomite
Limestone
Fine grained sandstone
Shale
Lithographic limestone
Breccia

Symbology Key

Dolomitic
Chert
Sandy
Shaly
Stromatoporoids
Unconformity
Vugs

System	Series	Stage	Lithostratigraphic Unit	Map Symbol	Lithology	Thickness (in feet)
Cretaceous	"Middle"		Dakota/ Windrow Formation	Kd		5-90
Devonian	Upper	Frasnian	Shell Rock Formation	Dsr		30-65
			Lithograph City Formation	Dlgc		70-105
	Lower	Givetian	Coralville Formation	Dcv		40-70
			Little Cedar Formation	Dlc		70-120
		Eifelian	Pinicon Ridge Formation	Dpr		30-50
			Spillville Formation	Dsp		50-80

Cedar Valley Group

Wapsipinicon Group

BEDROCK GEOLOGIC MAP OF MITCHELL COUNTY, IOWA

Iowa Geological Survey
Open File Map OFM-16-1
June 2016

Ryan Clark[1], Huaibao Liu[1], Phil Kerr[1], Stephanie Tassier-Surine[1], Robert Rowden[2], and Matthew Streeter[1]

Iowa Geological Survey, IIHR-Hydroscience & Engineering, University of Iowa, Iowa City, Iowa

Iowa Geological Survey, Robert D. Libra, State Geologist

Supported in part by the U.S. Geological Survey
Cooperative Agreement Number G15AC00242
National Cooperative Geologic Mapping Program (STATEMAP)
Completed under contract with the Iowa Department of Natural Resources

ACKNOWLEDGMENTS

Special thanks to Lindsey Falk and Brian Beaver of Falk Construction, Inc. and Bill Croell of Croell Redi-Mix for their insight and allowing us access to their quarries. Thanks to the following citizens of Mitchell County that allowed us access to their land: Shelly Breckenridge, Myron Friesen, Robert and Andrea Wrage, Gerald and Josephine Nash, Bob and Patti Kratz, Veronica Koenigs, Merlyn and Dorothy Gunsallus, Edwin Petersheim, Larry Kofoot, and Mark Duren. Zachary Demanett of the Iowa Geological Survey (IGS) and Austin Pothoff of the University of Iowa (UI) prepared well drilling samples for stratigraphic logging. Tanner Hartsock (UI) did an exemplary job of creating strip logs and assisting with data processing. Jason Vogelgesang (IGS) provided valuable depth-to-bedrock information via geophysical surveys in selected locations. Bill Bunker, Ray Anderson, Bob McKay, and Brian Witzke (IDNR-retired) provided valued background information concerning the bedrock topography, geology, and Devonian stratigraphy of the area. Thanks also to Rick Langel (IGS) for managing the Iowa geologic sampling database (GEOSAM). Administrative support was provided by Megan Delaney, Sara Conrad, and Teresa Gaffey.

[1]Iowa Geological Survey, IIHR-Hydroscience & Engineering, University of Iowa, IowaCity, Iowa
[2]Iowa Department of Natural Resources, Des Moines, Iowa

Introduction to the Bedrock Geologic Map of Mitchell County, Iowa

Mitchell County is located in north-central Iowa within the Wisconsin-age Iowan Surface landform region (Prior, 1991; Prior and Kohrt, 2006). This area has been subjected to multiple periods of Quaternary glaciations and subaerial erosion providing a relatively low-relief terrain with moderately incised drainage valleys.

The land surface of Mitchell County is mostly covered by Quaternary deposits The general thickness of undifferentiated Quaternary materials is variable, ranging from 0 to 14 m (0-45 ft). However, several prominent bedrock valleys exist within the mapping area with the thickest accumulation of Quaternary materials, up to 10C m (330 ft), lying within a north-south trending valley in the southeastern portion of the mapping area. Shallow bedrock information from the soil survey of Mitchell County (Voy and Highland, 1975) and unpublished historical records in the Iowa Geological Survey (IGS) archives were used for identifying potential bedrock outcrop locations during field mapping activities. Bedrock outcrops exist primarily along the Cedar and Little Cedar rivers and their tributary creeks, exposing bedrock of the Shell Rock, Lithograph City, and Coralville formations, primarily in the western two-thirds of the mapping area. Subsurface information was mostly derived from the analysis of water well cutting samples and one research core reposited at the IGS Oakdale rock library. More than 900 well records were studied with 665 from within Mitchell County. A total of 322 lithologic strip logs exist for Mitchell County, many of which were added as part of this mapping project. Lithologic and stratigraphic information from these samples are stored in the online GEOSAM database of the IGS. In addition to water well records, bedrock stratigraphic information from two sand and gravel pits, 13 quarries, and over 90 outcrops were utilized for this mapping project.

Paleogeographically, the mapping area is within the northern portion of the Devonian Iowa Basin, a region of thickened shelf carbonate and shale that was deposited from the late Eifelian through early Frasnian stage (Witzke et al., 1988). Middle and lower Upper Devonian rocks form the major bedrock surface and upper bedrock aquifers in this area. The hydrogeology of Floyd and Mitchell counties has been well studied (e.g., Libra and Hallberg, 1985 and Libra et al., 1994). Due to its stratigraphic completeness, rich fossil fauna, and hydrogeologic significance, the stratigraphy and depositional environments of the Devonian Iowa Basin have been intensively studied (e.g., Calvin, 1902; Belanski, 1927, 1928; Koch, 1970). More recent valuable geologic and stratigraphic studies of this basin include Witzke and Bunker (1984 and 1985), Anderson (1984), Bunker and others (1986), Witzke and others (1988), Day and others (1992), Bunker (1995), and Groves and others (2008).

Statewide bedrock geologic maps by Hershey (1969), and most recently by Witzke and others (2010), illustrate the improved understanding of the complex distribution of geologic units at the bedrock surface across north-central Iowa, including Mitchell County. Additional mapping efforts in north-central Iowa have been conducted by the IGS under the STATEMAP program since 2009, typically starting with 1:24,000 scale quadrangle maps and ending with 1:100,000 scale county maps. Bedrock geologic maps of north-central Iowa have been completed for Bremer County (McKay et al., 2010), Worth County (Liu et al., 2012), Black Hawk County (Rowden et al., 2013), and Cerro Gordo County (Liu et al., 2015). Results from these studies provided an important stratigraphic framework for this bedrock geologic map.

Seven bedrock formations comprise the bedrock surface of Mitchell County (in ascending order): the Devonian Spillville, Pinicon Ridge, Little Cedar, Coralville, Lithograph City, Shell Rock, and the Cretaceous Dakota/Windrow. The Devonian bedrock stratigraphic nomenclature and correlation for this map follows that established by Witzke and others (1988). The general lithologic features and thickness of each map unit are shown in the Stratigraphic Column and described in the Legend section of this map. For a more detailed description of the lithologic units and further discussion of mapping methodologies, please refer to the accompanying Summary Report.

References:

Anderson, W.I. (ed), 1984: General geology of north-central Iowa. Guidebook for the 48th Annual Tri-State Geol. Field Conf., 150 p.
Belanski, C.H., 1927: The Shellrock Stage of the Devonian. American Midland Naturalist, v. 10, p. 316-370.
Belanski, C.H., 1928: The Shellrock Stage of the Devonian; Description of some typical fossils of the Shellrock Stage. American Midland Naturalist, v. 11, p. 165-212.
Bunker, B.J., Witzke, B.J. and Day, J.E., 1986: Upper Cedar Valley Stratigraphy, North-Central Iowa, Lithograph City Formation. Geol. Soc. of Iowa Guidebook No. 44, 41 p.
Bunker, B.J. (ed), 1995: Geology and hydrogeology of Floyd-Mitchell counties, north-central Iowa. Geol. Soc. of Iowa Guidebook No. 62, 114 p.
Calvin, S., 1902, Geology of Mitchell County: Iowa Geological Survey Annual Report, v. 13, p. 293-338.
Day, J.E. and Bunker, B.J. (eds), 1992: The stratigraphy, paleontology, depositional and diagenetic history of the Middle-Upper Devonian Cedar Valley Group of central and eastern Iowa. Iowa Geological Survey Guidebook Series No. 16, 195 p., 3 parts.
Groves, J.R., Walters, J.C., and Day, J. (eds), 2008: Carbonate platform facies and faunas of the Middle and Upper Devonian Cedar Valley Group and Lime Creek Formation, northern Iowa. Iowa Geological Survey Guidebook No. 28, 96 p.
Koch, D.L., 1970: Stratigraphy of the Upper Devonian Shell Rock Formation of north-central Iowa. Iowa Geological Survey Report of Investigations 10, 123 p.
Libra, R.D. and Hallberg, G.R., 1985: Part 1. Hydrogeologic observations from multiple core holes and piezometers in the Devonian-carbonate aquifers in Floyd and Mitchell Counties, Iowa. Iowa Geological Survey Open File Report 85-2, p. 1-19, 5 figs, 6 tables.
Libra, R.D., Quade, D.J., Hallberg, G.R., and Littke, J.P., 1994: Groundwater quality, hydrogeology, and agricultural drainage wells: Floyd and Mitchell Counties, Iowa. Iowa Geological Survey Bureau Technical Information Series No. 29, 64 p., 25 figs., and 16 tables.
Liu, H., McKay, R., Rowden, R., Quade, D., Tassier-Surine, S., and Giglierano, J., 2012: Bedrock Geology of Worth County, Iowa. Iowa Geological and Water Survey Open File Map OFM-12-1.
Liu, H., Clark, R., Fields, C., McKay, R., Rowden, R., Tassier-Surine, S., Kerr, P., and Streeter, M., 2015: Bedrock Geology of Cerro Gordo County, Iowa. Iowa Geological Survey Open File Map OFM-15-1.
McKay, R.M., Liu, H., and Giglierano, J.D., 2010: Bedrock Geology of Bremer County, Iowa. Iowa Geological and Water Survey Open File Map OFM-10-10.
Prior, J.C., 1991: Landforms of Iowa. Univ. of Iowa Press, Iowa City, 154 p.
Prior, J.C. and Kohrt, C.J., 2006: The Landform Regions of Iowa, Iowa Geological Survey, digital map, available on the IDNR NRGIS Library
Rowden, R., McKay, R., Liu, H., Quade, D., Tassier-Surine, S., and Giglierano, J., 2012: Bedrock Geology of Black Hawk County, Iowa. Iowa Geological and Water Survey Open File Map OFM-13-3.
Voy, K.D. and Highland, J.D., 1975: Soil Survey of Mitchell County, Iowa. U.S. Dept. of Agriculture, Soil Conservation Service, 125 p., 70 map sheets.
Witzke, B.J. and Bunker, B.J., 1984: Devonian stratigraphy of north-central Iowa. Iowa Geological Survey Open File Report 84-2, p. 107-149.
Witzke, B.J. and Bunker, B.J., 1985: Part 2. Stratigraphic framework for the Devonian aquifers in Floyd and Mitchell Counties, Iowa. Iowa Geological Survey Open File Report 85-2, p. 21-32, 6 figs.
Witzke, B.J., Bunker, B.J., and Rogers, F.S., 1988: Eifelian through lower Frasnian stratigraphy and deposition in the Iowa area, central midcontinent, U.S.A. *in* McMillan, N.J., Embry, A.F, and Glass, D.J. (eds.): Devonian of the World, Canadian Soc. of Petroleum Geologists, Memoir 14, vol. I, p. 221-250.
Witzke, B.J., Anderson, R.R., and Pope, J.P., 2010: Bedrock Geologic Map of Iowa, 1:500,000. Iowa Geological and Water Survey Open File Map OFM-10-1.

Base map from Iowa DOT Road Map Layers 2006. Bedrock topography raster created internally for this map project.

Iowa Geological Survey digital cartographic file Mitchell_Co_BedrockGeology.mxd, version 6/30/16 (ArcGIS 10.3)
Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15 N, datum NAD83.

The map and cross-section are based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site specific studies.

Research supported by the U. S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G15AC00242. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U. S. Government.